

Regression analysis: USD/JPY rates and Japanese equities

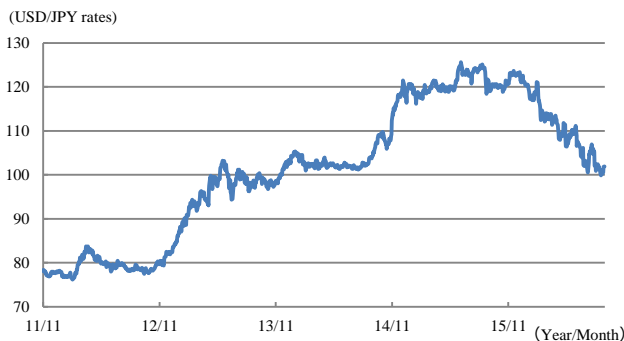
- We have conducted a regression analysis between FX rate of USD/JPY and Nikkei 225.
- Based on the data from Nov. 2011, 96.33% of the movements in Nikkei 225 can be explained by the movements in USD/JPY rate.
- Yet the estimated value for Nikkei 225 calculated by the regression analysis does not always coincide with the real stock prices.

We have conducted a regression analysis between FX rate of USD/JPY and Nikkei 225

It is generally perceived in the market that strong yen is the sign of ‘sell’ for the Japanese equities while weak yen causes investors to ‘buy’. Also in reality we often see the Japanese equities fall as yen appreciates and vice versa. What kind of relationships between the two exactly are there, and if any, to how much extent? We would like to verify it using a statistical method.

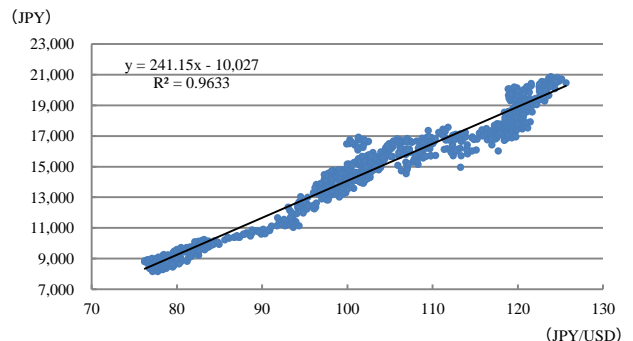
The yen obviously started to weaken and caused the Japanese equities to rally strongly on expectations for Abenomics from around the dissolution of the Lower House in November 2012 (see Chart 1). To seize the longer term movements, we extracted data samples of daily USD/JPY rates and Nikkei 225 from November 2011 to date. Regression analysis is applied to explain the relationship between USD/JPY rate and Nikkei 225 by an equation: ‘ $Y = aX + b$ ’. In this equation, X, or independent variable, is USD/JPY rate, and Y, or dependent variable, is Nikkei 225.

“Chart 1: USD/JPY rates”



(Note) Data period from 1 November 2011 to 29 August 2016.
(Source) SMAM based on Bloomberg L.P. data.

“Chart 2: Regression analysis between USD/JPY rates and Nikkei 225”



(Note) Data period from 1 November 2011 to 29 August 2016. Y axis for Nikkei 225,
X axis for USD/JPY rate.
(Source) SMAM based on Bloomberg L.P. data.

Based on the data from Nov. 2011, 96.33% of the movements in Nikkei 225 can be explained by the movements in USD/JPY rate

Chart 2 shows the results of the regression analysis. Here we obtained the solution ' $Y = 241.15X - 10,027$ ', where 241.15 is the slope 'a', and $-10,027$ is the intercept 'b' in the equation of ' $Y = aX + b$ '. That means, we can work out the value of Nikkei 225 (Y) by multiplying USD/JPY rate (X) by 'a' of 241.15, then adding 'b' of a negative 10,027.

From the formula's solution ' $Y = 241.15X - 10,027$ ', we can see that the progress in USD depreciation/JPY appreciation denotes the decreased value of X, leading to smaller value for Y (i.e. Japanese equity prices go down). On the other hand, USD appreciation/JPY depreciation means the increase in the value of X, leading to larger value of Y (i.e. Japanese equity prices go up). ' R^2 ' in Chart 2 is so-called coefficient of determination, denoting the extent to which independent variable X can explain dependent variable Y. ' R^2 ' at 0.9633 represents that 96.33% of the movements in the value of Nikkei 225 can be explained by the USD/JPY rate movements.

Yet the estimated value for Nikkei 225 calculated by the regression analysis does not always coincide with the real stock prices

We obtained the conclusion from the regression analysis that USD/JPY rate and Nikkei 225 has relationship that (i) strong yen leads to weak Japanese equities, (ii) weak yen lifts Japanese share prices, and (iii) significant part of changes in Nikkei 225 value can be explained by the movements of USD/JPY rates. If we plug in the recent USD/JPY rate of approx. JPY102=USD to the equation, the solution is $(241.15 \text{ times } 102) - 10,027 = 14,570$. This suggests the theoretical value of Nikkei 225 at JPY 14,570 given the recent USD/JPY rates, yet it is more than JPY 2,000 lower compared to the current actual stock prices. We can interpret this discrepancy as follows;

Equations estimated by a regression analysis are mere linearization of all the dots as shown in Chart 2; you would notice many dots are not aligned on the line if you take a close look at the chart. Accordingly, regression analysis can verify the relationship of USD/JPY rate and Nikkei 225, but the predicted value for Nikkei 225 by the equation does not always coincide with the actual stock prices.

*** Please note that this report is a translation of Japanese report written on 30th August, 2016.**

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